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Towards New Tests of Strong-field Gravity with Measurements of Surface Atomic Line Redshifts from Neutron Stars Simon DeDeo Department of Astrophysical Sciences, Princeton University, Princeton, NJ 08544 Dimitrios Psaltis School of Natural Sciences, Institute for Advanced Study, Einstein Drive, Princeton, NJ 08540

abstract In contrast to gravity in the weak-field regime, which has been subject to numerous experimental tests, gravity in the strong-field regime is largely unconstrained by observations. We show that gravity theories that cannot be rejected by solar system tests but that diverge from general relativity in the strong-field regime predict neutron stars with significantly different properties than their general relativistic counterparts. In particular, the range of redshifts of surface atomic lines predicted by such gravity theories is significantly larger than the uncertainty introduced by our lack of knowledge of the equation of state of ultra-dense matter. Measurements of such redshifted lines with current X-ray observatories such as Chandra and XMM-Newton can thus provide interesting new constraints on strong-field gravity.